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ABSTRACT

The goals of this practicum in science instruction for first grade students were to increase science instructional time, develop skills-appropriate instructional strategies, formulate relevant assessment methods, and promote positive attitudes. Grade level teachers met on six occasions to pinpoint science instructional deficiencies, formulate common goals, develop science unit experiences and assessment procedures, and participate in shared decision-making activities. Teachers kept daily records of science instructional time, and science lesson plans outlined hands-on activities, use of learning centers, and subject integrated strategies. Questionnaires were completed by students and parents to ascertain attitudes about science. The report includes a description of the community and work place, a problem description, a causative analysis, a literature review, a detailed outline of goals and expectations, an explanation of the methodology used, a discussion and evaluation of possible solutions, a discussion of results, and a list of recommendations. Students enrollment information, copies of the student and parent questionnaires on attitudes toward science, and a list of performance skills/objectives for science instruction on plants, environment, and the five senses are appended. (Author/KR)

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IMPROVING SCIENCE INSTRUCTION FOR FIRST GRADE STUDENTS THROUGH CURRICULUM DEVELOPMENT

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by

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Cluster 34

A Practicum I Report presented to the
Ed. D. Program in Child and Youth Studies
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

Nova University

1990

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PRACTICUM APPROVAL SHEET

This practicum took place as described.

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This practicum report was submitted by Wanda S. Vorsino under the direction of the adviser listed below. It was submitted to the Ed.D. Program in Child and Youth Studies and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova University.

Approved:

1-21-91
Date of Final Approval of Report

Dr. Polly Peterson, Adviser

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I would like to acknowledge my principal, Doris Burke, and the first grade teachers who were instrumental in the success of this practicum. Without their continued cooperation and dedication to the goals of this practicum, improvements in science instruction could not have been possible.

ABSTRACT

Improving Science Instruction for First Grade Students Through Curriculum Development. Vorsino, Wanda., 1990: Practicum I Report, Nova University, Ed.D. Program in Child and Youth Studies. Descriptors: Elementary Science/Hands-On Activities/Science Education/Teaching Methods/Science Activities/Curriculum Integration/Interdisciplinary Programs/Science Skills Assessment

This practicum endeavored to improve science instruction for first grade students. The goals of the practicum were to increase science instructional time, develop skills-appropriate instructional strategies, formulate relevant assessment methods, and promote positive attitudes.

Grade level teachers met on six occasions to pinpoint science instructional deficiencies, formulate common goals, develop science unit experiences and assessment procedures, and participate in shared decision-making activities. Teachers documented science instructional time daily. Science lesson plans outlined hands-on activities, learning centers, and subject integrated strategies. Questionnaires were completed by students and parents to ascertain attitudes about science.

Outcomes of this practicum illustrated that barriers to the improvement of science instruction can be overcome. The commitment of the classroom teachers and their ability to problem solve became instrumental in the success of the practicum. The data from this practicum demonstrate the following avenues for science instruction: (a) teacher commitment is essential to curriculum change, (b) hands-on activities, subject integration, and discovery-based learning centers significantly increase science instructional time, (c) developmental and skills appropriate science experiences promote positive student attitudes, and (d) parent involvement in science education develops positive attitudes in parents.

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CHAPTER I

INTRODUCTION

Description of Community

The target school is located in a southern, multi-ethnic, low income, urban community. The population, stability, and socio-economic structure of the community which the school serves has changed dramatically over the past few years.

Hispanic immigrants, migrant workers, and northern transplants have caused the number of residents in the area to more than double. In addition, families have become more transient. In 1989, approximately twenty-five percent of the community's families relocated either into or out of the area as compared with ten percent in 1984.

In 1988, rezoning drastically changed the socio-economic structure of the school's

clientele. Previous to school district rezoning, the target school had serviced students from the surrounding area which is primarily a low-income neighborhood heavily populated by racial minorities. Rezoning resulted in the school servicing students from the surrounding community and those from an area of considerably higher socio-economic status. The backgrounds, incomes, education, and careers of the families from the two areas are at opposite ends of a socio-cultural continuum. As a result of the dissension caused by the rezoning, the target school has become the focus in political controversy dealing with racial prejudice, district policies and procedures, and equal access to quality education. Although the school administration has effectively dealt with and improved public relations with the various community factions, families from the lower socio-economic neighborhood adjacent to the school are hesitant to become actively involved in school functions and view school activities, administrative decisions, and teacher behaviors with

skepticism.

Description of the Work Setting

The school facility is composed of six clusters, three large buildings, ten portable classrooms, and a large area for outdoor activities. Each cluster consists of five pod-like self-contained classrooms which are grouped around an outdoor atrium and connected by outside sidewalks. Two of the large buildings house a total of fifteen individual classrooms. The third large building serves as the school cafetorium. The portables are used for special classes of students with learning disabilities or emotional handicaps.

Although the school was designed for self-contained instruction, many teachers team-teach for reading, math, social studies, and science. Cross-teacher cooperation minimizes the number of ability groups and subjects for each teacher and facilitates individualized

instruction.

Student enrollment in grades K-5 and Exceptional Student Education classes slightly exceeds 750 children (See Appendix A for population data). The student-teacher ratio in the primary grades averages 23:1. In the upper grades, the ratio averages 25:1.

Community and parental involvement is exemplified by a supportive Parent-Teacher Association, an active volunteer program, and a School Advisory Board. This participation facilitates positive communication between the school and the neighborhood, provides enriching educational opportunities for the students, and establishes a committment to quality instruction.

The organizational climate of the target school encourages staff professionalism and promotes a high-task orientation. Formal communication channels between the administration and the staff members are maintained through a daily bulletin, faculty meetings, Effective School Committee meetings, and organizational committee

meetings.

The school maintains a high goal focus. As a result of extensive self study through the Effective School Plan Program and the Merit School Program, faculty members have developed specific organizational objectives. Innovation in implementation of school objectives is supported by the administration in order to meet established standards of excellence.

Writer's Work Setting and Role

This is the writer's first year as an employee and as the assistant principal of the target school. The writer has been an elementary teacher for 15 years. Her experience includes seven years with various stateside public schools and eight years with Department of Defense Overseas Schools in West Germany.

As assistant principal, the writer supervises 50 classroom teachers and 25 teacher assistants.

As a supervisor, it is her responsibility to assist instructional personnel in improving educational practices and experiences for students. This includes psychological and technical support, curriculum development, professional development of personnel, and evaluation of personnel performance, educational outcomes, and curriculum goals. The writer also organizes and maintains community-school partnership programs; handles student discipline problems; verifies data for computer-management information services; presides over exceptional student education staffing conferences; finalizes scheduling for educational programs and events; and, chairs various curriculum, school, and district organizational committees.

CHAPTER II

STUDY OF THE PROBLEM

Problem Description

At the district, school, and classroom level, science was an often neglected subject. At the district level, teacher training in science instructional methods had been nominal, policy was ignored, and instructional support did not exist.

The district offered economic and personnel support for instructional excellence in reading and math. Math and reading resource personnel were available upon request for individual or group assistance on effective teaching strategies. Teachers new to the district were required to attend a math and reading orientation on basic objectives, pupil progression, evaluation, and teaching strategies. Staff development for science was virtually non-existent.

District policy provided strict guidelines in reading and math for minimum academic requirements for instruction. Evaluation procedures and instruments were consistent throughout the county. In contrast, district guidelines for science have been generally ignored, there were no minimum requirements for instruction, and evaluation was left to the discretion of the teacher.

At the target school, average time-allotments for science in first grade were lower than state minimum requirements. Teachers often omitted science in order to complete instruction in reading and math. When science instruction did take place, teaching strategies were limited to written activities and presentations which stressed reading and memory skills.

Student interest in independent science activities was not encouraged. The writer observed no hands-on activities, learning stations, or centers that related to science in first grade classrooms.

In conclusion, science instruction for first

grade students at the target school was a low priority characterized by insufficient time allotments, ineffective teaching strategies, little district/administrative support, and low student interest.

Problem Documentation

Documented evidence supported the deficiencies of science instruction for first grade students. Many proponents of science instruction advocate hands-on activities as an effective teaching strategy. The writer questioned each of the six first grade teachers on their use of hands-on activities for science instruction. Five of the teachers had used no hands-on activities in the present school year.

The school Science Fair provided students with the opportunity to demonstrate their interest and expertise in scientific methods and topics. There were no entries from first grade students in the Science Fair.

Science performance objectives did not include investigative techniques, scientific inquiry skills, and methods of documentation. Resource materials which were developed to facilitate instruction were not applicable to the procedures and methods inherent in science instruction. The materials stressed vocabulary without concept development, over-simplified written activities, and workbook pages for practice and evaluation.

The weekly time allotment for science instruction recommended by the state was 90 minutes. The district did not specify time allotments for science instruction. The writer asked the six first grade teachers to keep a daily log of the amount of time spent on science for a four week period. As seen in Table 1, time allotted for science instruction was below the 90 minute minimum standard in all classes.

Table 1

Recorded Minutes of Science Instructional Time in First Grade Classes

	Weeks			
Teacher	1	2	3	4
A	45	30	30	40
B	30	20	35	30
C	60	50	60	45
D	30	25	40	30
E	50	20	50	45
F	30	50	45	60

Student achievement in science was below that of language arts and math. It was the policy of this district that the highest grade a first grade student could earn in science was an "S" which stands for satisfactory. There was no recognition of students who might excel in science.

District sponsored science inservice training was insufficient. This school year (1989-1990), two teachers from the target school, with a

faculty of fifty, attended one science-related training session. Yet, the district required the entire faculty to attend four reading and five math inservice training workshops.

Causative Analysis

The problems associated with science instruction may be caused by a combination of district policies, administrative goals, financial limitations, building layout, and teacher training. District policies emphasized achievement in reading and math through formalized behavioral objectives and uniform evaluation procedures. Since science instruction, student performance, evaluation, and training have not been addressed by the district, the indirect message to school administrators and teachers was that science is not important. Therefore, teachers justified omitting science because of its low priority and district emphasis on reading and math performance.

The school administration, taking its cue from the district, emphasized basic skills achievement. Evaluation instruments were standardized, documentation of skills was closely monitored, and deficiencies in student progress resulted in specific action plans for remediation. Whereas, achievement in science was based on teacher observation and/or teacher-made tests and specific concepts for promotion had not been identified (Yager, 1986). Evaluation techniques were not standardized nor did they assess knowledge of basic scientific concepts or skills. Because of the lack of attention to science as an academic subject by the administration, most teachers were not motivated to improve instruction, develop innovative teaching techniques, or even teach science.

Classroom management procedures can discourage science instruction (James & Hord, 1988). Hands-on activities, which are basic in teaching science, involve certain amounts of

directed movement and task-centered verbal exchange. The noise level which this strategy entails was not approved by the previous administration. Rather, those supervisors encouraged a silent, structured classroom that was individually task-oriented. From their standpoint, student interaction resulted in overall distraction and signaled off-task behavior.

Some teachers cited ill-designed building facilities as impediments to science instruction. Classrooms without a sink, running water, storage areas, accessible electric outlets, and/or work centers affected the quality of science experiences.

Another barrier to science instruction was the discomfort teachers felt when dealing with the subject (Shymansky, 1989). The discomfort might stem from insufficient background in content and teaching strategies and/or previous experiences in science which were unrewarding or unpleasant. These teachers not only avoided teaching science,

but when they did teach it, they conveyed negatively biased attitudes of science to their students (Kyle, Bonnstetter, and Gadsden, 1988).

Budget limitations have also influenced the way science is taught. The district maintained that funds were not available to support improved standards, to establish standardized evaluation, and to train instructional personnel. The school had insufficient funds to purchase science equipment and resource materials due to rising costs of building maintainance, basal texts, and equipment expenses. As for supply money allotted to teachers, funds barely covered the costs of basic materials (paper, pencils, art materials, etc.). However, to consider a budget as a cause of inadequate science instruction, one must also remember that the budget is also a function of policy, priorities, and preferences.

Relationship of the Problem to the Literature

Researchers, practitioners, and the

interested public are realizing that American education is failing to provide its children with the technological and scientific skills required in the future. Nobel prize winning physicist, Leon Lederman, states that schools take "naturally curious, natural scientists and manage to beat the curiousity out of them" (as cited in Begley, Hager, Barrett, & Joseph, 1990, p. 55). This statement is supported by research which indicates that the number of students interested in science dwindles as they progress through school. By third grade, one-half of all students consider science their least favorite subject. When students reach eighth grade, only one in five elect to continue taking science subjects and at graduation only seven percent of high school students are prepared to take college level science courses (Cowley, Springen, Barrett, & Hager, 1990). Furthermore, 90% of all children taught, upon reaching adulthood, will have little or no interest in science (Yager, 1986). According to Pizzini (cited in Cowley et al., 1990), students avoid

science-related subjects because of lack of interest, unsuccessful experiences with the subject, and/or the attractiveness of other subjects.

In addition to decreased student interest in science, scores on standardized tests of science achievement are below that of students in other countries. On tests given to high school students in thirteen countries, American students rank eleventh in chemistry, ninth in physics, and thirteenth in biology (Cowley et al., 1990). Voelker (1982) states that students tend retain little of what is taught. He gives the example of the concept of a molecule. The concept is taught from elementary through high school. However, only 25% of students at graduation have a working knowledge of a molecule (Voelker, 1982).

Educational practitioners must face the fact that education--as it is today--is failing to promote technological and intellectual skills needed for the 21st century (Kyle et al., 1988). Some instructors believe the cause is related to

the way science is taught. In 1988, a study conducted with the schools of the Richardson Independent School district found that the majority of science classes were using instructional strategies identical to those used in language arts classes and that instruction focused on low level cognitive skills (Kyle et al., 1988).

While some experts believe the problems associated with science instruction are caused by the practices of classroom teachers, others point to problems with education from a broader standpoint. In the 1960's, three elementary science curriculum programs (the Science Curriculum Improvement Study (SCIS), Science: A Process Approach (SAPA), and the Elementary Science Study (ESS)) were regarded as solutions to the problems in elementary science education and supported by the National Science Foundation (NSF). The three programs were noted for their accurate research-based science content, attention to developmentally appropriate teaching

strategies, and the emphasis on inquiry techniques, hands-on activities, and "discovery" learning. Yet, these programs failed to change the way science was taught. Instead, teachers relied more heavily on textbooks, lecture, and discussion to teach science.

Research has provided evidence that the failure of these programs was due to unsuccessful implementation (James & Hord, 1988). Obstacles which contributed to failure included the low priority standing of science in comparison to other school subjects; limited backgrounds of teachers in science content and teaching methods; unclear district policies about science teaching; the omittance of science on stanadardized tests; minimal time allocations; inappropriate facilities and equipment; the lack of district and administrative support with respect to financial allocations; teacher training and instructional supervision; and, inadequate undergraduate teacher preparation in scientific processes and concepts (James & Hord, 1988). This research suggests that

the true impediment to improvement in science education in elementary school is the lack of understanding of the change process.

Additional research has shown that there is a discrepancy in what elementary education practitioners believe they ought to do and what they actually do in their schools and classrooms. Seventy-six percent of elementary school principals and sixty-six percent of elementary teachers consider laboratory-based science curriculum and hands-on experiences the most effective science instructional strategies (Weiss, 1987). However, in 1987, a survey conducted by Weiss demonstrated that only 51 percent of the K-6 classes involved students in hands-on activities. In real practice, teachers stressed factual information which was disconnected from daily experiences and concept development (Bybee, Buchwald, Cressman, Heil, Kuerbis, Matsumoto, & McInerney, 1989). It seems that although elementary educators are aware of the unique strategies in science education, they have not been given the tools and

direction necessary for improvement. Inadequate training, negative experiences, lack of administrative support, superficial content knowledge, and reliance on attractive pre-packaged science textbook programs have all contributed to the stagnancy in elementary science education.

Public attitudes relating to science instruction have changed significantly in the last few years. According to recent research, the perceived importance of science instruction has changed from preparation for further study to meeting personal needs, resolving societal issues, and career awareness (Yager and Penick, 1988).

Business leaders and public officials are concerned about the economic future of the United States without technologically prepared adults. As it is now, more than half of the doctorate degrees in the scientific fields are awarded to foreign nationals (Cowley et al., 1990). Even more dramatic is the number of minority citizens in science-related fields. In 1986, only 2.5 percent of science professionals were black and an

even smaller percentage were Hispanic (Cowley et al., 1990). In five years, analysts predict a serious shortage of doctoral level scientists in the U.S. unless something is done to attract students--particularly minorities and females--into science-related fields of study.

In summary, the problems which commence with poor science instruction have far-reaching implications. The literature suggests that technology of the future will demand a population familiar with scientific concepts and processes enabling them to make intelligent decisions on societal issues; workers who have technological skills; and, highly trained scientists able to stay abreast of increasingly sophisticated technological innovations. Without a basic foundation in science, many children will face a society which they are ill-equipped to handle. The "crisis" will affect each individual's daily life adversely, unless, education moves to bridge the gap between scientific processes and the techniques used to teach science and increases instructional

time for science.

CHAPTER III

ANTICIPATED OUTCOMES AND EVALUATION INSTRUMENTS

Goals and Expectations

The anticipated outcome of this practicum was the improvement of the quality of science instruction. In general, the goals of the proposal were to increase time spent on science activities, to develop science instructional units which actively involve students and correspond with district objectives, to cultivate positive attitudes in students and parents with respect to science, to improve student participation on independent science activities, and to relate science to real world problems and societal issues.

Behavioral Objectives

The following goals and objectives were projected for this practicum:

1. A time allotment of at least 90 minutes a week for science instruction will be maintained throughout the implementation period as documented in a daily log by the writer and verified by a supervisor.
2. Ninty percent of the students will achieve 85% mastery on each of the science units as documented on the evaluation instruments for each unit.
3. Ninty percent of the students will complete a home science activity by the conclusion of each science unit as documented by the writer.
4. One hundred percent of the parents and students will exhibit a positive attitude toward science by responding positively to 8 out of 10 statements on a questionnaire developed by the writer.

5. By the completion of each science unit, cooperative student groups will have completed 3 out of 4 science activities which involve a visible product.
6. By the next grading period, 90% of the target students will earn an "S" (Satisfactory) on their report card.
7. Ninty percent of the students will be able identify 8 out of 12 science-related careers when given visual and/or oral cues by the end of the implementation period.
8. Ninty percent of the students will be able to illustrate 2 out of 3 science issues in society by the end of the implementation period.
9. Ninty percent of the students will master 10 out of 12 grade-level objectives presented during the implementation as documented on unit evaluation instruments.

Measurement of Objectives

The writer views assessment as an ongoing monitoring process used to shape instruction and to evaluate what students know and their ability to apply what they know. Therefore, assessment was both formative and summative throughout implementation. Formative assessment was used to improve learning; such as, in the formation of groups, in the determination of skills instruction, and for diagnostic purposes in remediation. Summative assessment was used to evaluate student knowledge and to determine the achievement of each objective.

The writer used a variety of methods to evaluate the success or failure of each objective. A daily log documented time allotments for science (Objective #1). A supervisor verified time allotments by checking lesson plans and periodic observations.

Assessment for each science unit (Objective

#2) was comprised of three parts; measures of student participation in classroom activities, application of concepts in other situations, and recognition of science-related careers and evironmental issues. So, rather than one evaluation instrument the writer used a series of tasks to obtain a more realistic picture of what each student knew. Each segment of evaluation was worth 30 points for a total of 90 points as the perfect score. Mastery was determined by the students' score on each segment: mastery being 85 percent or 25.5 points.

Student participation was evaluated daily. Out of two possible points each day a student earned one point for on-task behavior during a science activity and one point for active participation; such as, asking or answering questions or performing assigned tasks.

Assessment of concept application was conducted individually or in small groups with manipulatives, diagrams, study prints, and personal interviews. This segment of evaluation

was performance-based. The student was given three tasks to perform. The writer observed each student's behavior, questioned when appropriate, and recorded information which demonstrated concept understandings. The successful completion of each task was worth 10 points for a total of 30 points.

To assess each student's understanding of science-related careers and societal issues, each student was shown ten small prints or pictures. Of the ten pictures, three were of science-related careers, three were of societal/environmental issues, and four were random selections from a children's magazine. Each student was asked to describe the pictures in his/her own words while the writer recorded pertainent comments. Correct responses to the six science-related pictures were worth five points each for a total of 30 points in this segment of evaluation. Information from the results of the unit "tests" were also used to evaluate the success of Objectives #6, #7, and #9.

Parent-teacher communication was inherent in

the home science activity (Objective #3). To satisfy this objective a letter was sent to parents to introduce the concept of the home activity and to clarify the responsibilites of the students in completing the tasks. The students had a variety of options from which to choose. The activities were completed at home and brought to school by the culmination of each science unit.

Attitudes towards the science units and science, in general, were ascertained at the completion of all science units (Objective #4). Student attitudes were determined by their responses to a 10-item questionnaire (Appendix B) which was given by reading each item to the students. The students responded to each statement on the questionnaire by coloring in a happy face (positive) of a sad face (negative). A separate but similar questionnaire was sent home for parents to complete and return (Appendix C).

Objective #5 measured another affective domain of the proposal. Students worked in groups to complete a specific product. A designated time

one day a week was ear-marked for group work. A chart was used to record the progress of each group.

Rather than use one test to measure student recognition of careers (Objective #7), these items were included on the evaluation instrument for Objective #2. Items for assessment of Objective #7 were divided equally among the science tests.

Students illustrated science issues in society (Objective #8) during science lessons. A variety of artistic media was used. Students were allowed to show and explain their finished illustration. The final products were collected, appraised, recorded, displayed, and kept in student portfolios for final evaluation.

Mastery of grade level objectives (Appendix D) was determined by performance on the summative evaluation for each unit and/or teacher observation when applicable. Methods of assessment of the various objectives were determined by the skill which the student was required to demonstrate. The writer felt that

this agreed with the holistic approach toward science assessment.

Mechanism for Recording Unexpected Events

The writer kept a journal during the implementation of the proposal to record behaviors and/or events which were not anticipated, yet, were direct results of interventions inherent to this proposal. The writer also collected samples of student work, encouraged comments from her supervisor, and either video taped, photographed, or tape recorded certain science activities.

CHAPTER IV

SOLUTION STRATEGY

Discussion and Evaluation of Possible Solutions

Possible solutions to the "crisis" of science education range from broad curriculum changes to implementation of specific classroom practices. In the succeeding pages, the writer will briefly discuss and evaluate several instructional techniques which might improve science teaching methods.

A popular instructional method of science professionals is the hands-on approach. Sometimes called the inquiry-based, process approach, this method advocates emphasis on scientific processes and positive science experiences. Kyle, Bonnstetter, and Gadsen (1988) evaluated the effectiveness of an inquiry-based, process-approach science program in grades K-6

when compared with traditional science programs. After its first year of implementation, they found that students in the process-approach classes exhibited positive attitudes in science, developed advanced questioning techniques, increased their level of curiosity, and experienced success in their scientific learning experiences (Kyle et al., 1988). Data also suggest that students involved in inquiry-oriented, process-approach science programs have high scores on standardized tests of general science achievement, process skills, analytic skills, language arts and mathematics (Shymansky, Kyle, and Alport, 1983). However, Charles Anderson, a professor of teacher education at Michigan State University warns that a "mindless hands-on science program is as possible as a mindless textbook program" (cited in Begley et al., 1990, p.56).

Three hands-on, activity-based programs developed in the sixties and seventies have recently generated renewed interest. Elementary Science Study (ESS), Science Curriculum

Improvement Study (SCIS), and Science--A Process Approach (SAPA) epitomized the science reform movement of the era. They stress problem solving, process skills, creativity, and positive attitudes. Instructional strategies incorporate working with live materials, outdoor investigations, inquiry lessons, audio-visual materials, and classroom libraries (Kyle, Bonnstetter, and Gadsen, 1988). A meta-analysis of the research on the effectiveness of these programs resulted in data which demonstrated that students involved in a hands-on, activity-based program performed better on measures of general achievement and problem solving skills (Shymansky, Hedges, Wordworth, and Berg, 1986).

Based on research, hands-on, process-approach teaching strategies are necessary components of science instruction. These strategies are not widely used because they require detailed planning, teacher training, and specific materials. And yet, can science instruction be efficacious without hands-on activities and

scientific processes?

Penick and Yager (1986) affirm that students learn more science from experiences unrelated to school science. They endorse extending science lessons to include the community and advocate the use of problem-solving methods when dealing with real environmental issues. Building scientific knowledge by using actual experiences greatly increases student achievement, interest, and technological sophistication (Penick and Yager, 1986). Although their teaching strategy is founded on research, practical applications are limited to secondary school.

Early childhood experts believe that science instruction for children ages three to eight should relate to other areas of the elementary curriculum (Zeimer, 1987). In lieu of science being an isolated experience, it should interact with art, music, math, and literature in what might be called a "wholistic" approach. Those who advocate this approach maintain that concepts are learned more easily because they are whole,

meaningful, and functional (Cutting, 1988).

Research also shows that science experiences actually facilitate the development of basic language and reading skills (cited in Fehrenbach, Greer, and, Daniel, 1986). The Language Experience Approach (LEA) teaches beginning and remedial reading by combining students' experiences with their language patterns. Evidence suggests that LEA students can read, write, spell, and compose stories better that students in other reading programs (Grabe, 1981).

The wholistic approach and LEA would integrate subjects so that teachers would be able to effectively use a limited amount of time without sacrificing one subject for another. Purchases of additional materials would be minimal, however, extensive planning is essential.

Learning centers encourage students to explore independently when science materials are at a premium, space is limited, and time does not allow for hands-on group experiences (O'Sullivan, 1984). Research suggests that learning centers

stimulate cognitive and affective development (Flavell, 1977; Kosmoski, 1978). They are also excellent avenues for individualized activities (Blake, 1977). Centers are also attractive because they can be used without dramatic instructional or external classroom changes.

Since a major reason for omitting science is the emphasis on language arts, perhaps a solution would be to use language arts to enhance science learning. Expository writing is a composition method used to develop and record questions, define technical vocabulary, chart experiments, state facts and concepts, list qualities, classify items, summarize events, cite reasons, compare data, describe processes, and explain findings (Koeller, 1982). According to Cudd and Roberts (1988), expository writing enhances understanding in content areas and fosters retention. This teaching strategy uses language arts skills to teach science content. Although this instructional method is beneficial, it should not be used exclusively because it provides no practice in

scientific processes.

Other interventions which might improve the quality and quantity of science instruction are; using volunteers to assist with hands-on activities (Feldman, 1987); creating an outdoor science lab for primary students (Schneider, 1984); developing teachers' questioning techniques to be used with an inquiry approach (Fields, 1989); and, writing a grant to procure funds for science materials and equipment (Feldman, 1987). Volunteers have always been welcome at the target school, but, the writer has had little dependable volunteer participation in the past school year. Single parent families, small children, and the necessity for double incomes decrease the amount of adults able to become school volunteers. Creating an outdoor science laboratory would entail more time, community cooperation, and funds that are unavailable to the writer. Developing teachers' questioning techniques would encourage student participation in all subjects. Presently, the writer is not in a position to enact such an

intervention. Finally, writing a grant for equipment and materials is a solution for only one aspect of the instructional problem. Equipment and materials accomplish nothing without use. Also, grants are approved when there is evidence of previous commitment. The writer believes a grant proposal would be more appropriate after success with this proposal has been accomplished.

Description of Solution Selected

The writer was prepared to use a combination of various instructional strategies to improve the quality and quantity of science instruction. She realized that she must work within the existing structure of district policy and school procedures to overcome limitations of time, materials, equipment, and funding.

By integrating science into other aspects of the curriculum, instruction should become meaningful and time spent on science-related activities was predicted to increase. The writer

also planned to relate science to other curriculum areas. This instructional strategey has been confirmed by research to facilitate cognitive development in primary children (Zeimer, 1987).

The writer intended to use learning centers to foster independent discovery, promote student cooperation, and stimulate curiousity. The independent nature of learning centers encourages students to practice skills in addition to regular classroom activities without censure, to use task-specific vocabulary, and to feel successful about what they have accomplished (Kosmoski & Vockell, 1978).

Hands-on activities are basic to science instruction (James & Hord, 1988). Rather than isolated events, these activities should be used to stimulate discussion, language experience activities, inquiry techniques, career awareness, and environmental issues. Using hands-on activities to stimulate and/or enrich skills retains the structure necessary for meaningful instruction (Cutting, 1988).

CHAPTER V

RESULTS, DISCUSSION, AND RECOMMENDATIONS

Results

The problems which this practicum addressed were the deficiencies of first grade science instruction. Instructional activities were inappropriate, time was not alloted for science instruction, teachers were uncomfortable teaching science, science held low priority as an academic subject, students were not interested in science, and there was no district/administrative support to improve science instruction.

To solve the problems with science instruction, the writer initiated a change process to improve science curriculum, developed goal commitment, empowered teachers to enhance instruction, and facilitated innovative practices. To improve teacher attitudes and build goal

commitment, the writer followed the Concerns-Based Adoption Model (CBAM) for curriculum change (Hal & Loucks, 1978). Through this process the teachers pinpointed deficiencies, formulated objectives, and outlined strategies for successful implementation. At grade level meetings teachers chose skills, concepts, and vocabulary to be taught; identified developmentally and conceptually appropriate science activities; listed available supplies and audio-visual materials; formulated holistic formative and summative assessment methods; suggested activities for curriculum integration; shared hands-on activities and projects; designed discovery-based learning centers; and, discussed documentation of student performance.

Because this practicum was implemented with all first grade students, the results of each objective reflected success or failure based on six classroom teachers and 124 students.

Objective One stated that a time allotment of at least 90 minutes a week for science instruction

will be maintained throughout the implementation period as documented in a daily log. Each teacher recorded time spent on science activities in their lesson plan books on a daily basis. Science activities included science lessons; activities which integrated science with art, math, social studies, or language arts; field trips; and/or read-aloud science stories. Table 2 illustrates the average weekly time allotments for each first grade teacher during implementation.

Table 2

First Grade Teachers Weekly Time Allotments (in minutes) for Science

	Week											
Class	1	2	3	4	5	6	7	8	9	10	11	12
A	90	95	95	130	110	110	120	150	160	150	150	140
B	90	90	90	95	100	100	100	110	110	120	120	120
C	90	90	95	95	95	100	100	100	120	120	110	130
D	90	90	90	95	90	100	100	100	110	110	120	120
E	90	90	95	95	95	100	110	100	100	110	120	130
F	90	90	95	90	95	110	120	120	120	120	130	130

As noted in Table 2, time allotments for science instruction met and exceeded the amount specified in Objective One.

According to Objective Two, ninety percent of the students would achieve eighty-five percent mastery on each of the science units as documented on the evaluation instruments for each unit. As explained previously, the evaluation instruments for each science unit consisted of three segments. Evaluation was often accomplished by teacher observation. Performance-based tasks were conducted in small groups or individually, and exemplary student works were collected in portfolios. Student knowledge of concepts and skills were assessed for each of the three science units taught (Plants, The Environment, The Five Senses). The results of assessment as shown in Table 3 documents the success of Objective Two.

Table 3

Mastery of Unit Evaluation by Class and Topic

	Unit		
Class	Plants	Environment	Senses
A	100	95	100
B	100	100	95
C	100	100	100
D	95	100	90
E	100	95	100
F	90	100	100

Note: Numbers represent the percent of students in each class who scored 85% or higher on unit evaluations.

Objective Three stated that ninety percent of the students will complete a home science activity by the conclusion of each science unit. Table 4 illustrates that this objective was met in all but one class (Class E). The writer feels the failure

to achieve this objective in this class was because the class is comprised of students whose home language is not English. If the activity was understood at all, it was because of the initiative of the student. With that in mind, the writer feels the results from this class are impressive.

Table 4

Students Completing a Home Science Activity by Class and Unit

	Unit		
Class	Plants	Environment	Senses
A	100	95	90
B	100	100	90
C	90	95	100
D	95	100	95
E	85	80	80
F	90	95	90

Note: Numbers represent percent.

Table 5

Percentage of Parents Responding Positively to Eight of Ten Questionnaire Items

	Category	
Class	1	2
A	100	95
B	100	90
C	100	85
D	100	95
E	100	60
F	100	95

Note: Category (1) represents percentage of positive responses from questionnaires that were returned. Category (2) shows the percentage of positive responses with respect to questionnaires sent.

In Objective Four, one hundred percent of the parents and students will exhibit a positive attitude toward science by responding positively

to 8 out of 10 statements on a questionnaire developed by the writer. In every first grade class 100% of the students answered at least 8 out of the 10 items positively.

The writer found the parent segment of the objective difficult to assess because all the questionnares were not returned. Table 5 categorizes positive responses.

Although 100% of parents who returned questionnaires reponded positively, the writer did not consider in writing the objective a lack of response. Because of the deficiency in the objective, the writer concludes that the objective, as written, was not met.

Objective Five stated that by the completion of each science unit, cooperative student groups will have completed three out of four science activities which involve a visible product. This objective became an integral part of the weekly lesson plans. Teachers scheduled one group activitiy each week during implementation. Every student group completed four out of the four

science activities which involved a visible product.

Objective Six stated that 90% of the target students will earn an "S" (Satisfactory) on their report card by the next grading period. The results exceeded the goal for this objective. For the first grading period of this school year one hundred percent of first grade students earned an "S".

For Objective Seven, ninety percent of the students would be able to identify eight out of twelve science-related careers when given visual and/or oral cues by the end of implementation. Because study prints for visual cues were unavailable and teachers wanted to depart from total-group, paper-and-pencil evaluation, this objective was assessed through the use of portfolios. Work completed by students pertaining to science-related careers were collected and recorded. Individual interviews on student drawings contained in portfolios assessed student knowledge of science careers. This objective was

successful because students were able to identify twelve out of twelve science-related careers.

In Objective Eight, ninety percent of the students were required to illustrate two out of three science related issues in society. During implementation, teachers integrated social issues which were science related into the social studies curriculum. Students were able to illustrate three out of three societal issues related to science units. The writer attributes the success of this objective to subject integration.

Objective Nine required ninety percent of the students to master ten out of twelve grade level objectives presented during the implementation as documented on unit evaluation instruments. As noted previously, there was no instrument, per se; rather, teachers used a variety of methods to assess student mastery. As students demonstrated knowledge of concepts and/or skills, teachers noted mastery on a performance list kept in the student's portfolio. The twelve objectives presented during implementation are listed in

Appendix D. By the conclusion of implementation, every first grade student had mastered all twelve skills/objectives. The writer must point out that this does not mean that all students mastered the objectives simultaneously. Because of the formative nature of assessment during science instruction, teachers effectively individualized instruction to meet student needs. Therefore, teachers guaranteed success for all first grade students.

Discussion

The objectives in this practicum addressed many deterrents to effective science instruction: time, content and instructional strategies, evaluation, and attitudes.

Time is an indication of the importance placed on an academic subject; the amount of time also influences student learning. For teachers at the target school, time was percieved as a barrier to science instruction. This barrier diminished with creative subject integration. Although the

time allotments at the conclusion of the practicum were significantly greater than those previous to intervention, they do not consistently meet the two and one-half hour minimum allotment suggested by the National Science Teachers' Association (Loucks-Horsley, Carlson, Brink, Horwitz, Marsh, Pratt, Roy, & Worth, 1989).

Science content and instructional methods were another identified impediment to effective instruction. Teachers were uncomfortable with content and, at the same time, felt district materials were inappropriate and stimulated little, if any, student interest. These deficiencies led to ineffective teaching methods, superficial conceptual development, and negative teacher and student attitudes toward science. By providing teachers with sufficient background information, outlining concepts and skills for specific topics, and creating opportunities to design and share developmentally and instructionally appropriate materials, science content became exciting to students and teachers

alike. Teachers noted that the activity-based instructional methods developed skills in observation, inferrence, and classification; improved dexterity and psychomotor functioning; and, contributed to the improvement of reading, math, and communication skills. These results agree with findings of studies conducted with laboratory-based programs (Skymansky, Kyle, Alport, 1982). In addition, by involving parents, the school community became aware of the need for the acquisition of scientific knowledge and the ease with which a simple activity can be transformed into a science experience.

Available tests were simple to administer, score, and analyze; however, they failed to correspond with the curriculum, assessed general science knowledge at lower cognitive levels, and were limited in the type of skills they evaluated. In response to these testing realities, teachers formulated alternative methods of assessment. The National Center for Improving Science Education proposes that assessment should guide subsequent

science instruction (Raizen, Baron, Champagne, Haetel, Mullis, & Oakes, 1989). Evaluation in this practicum was designed to be an ongoing process which monitored instruction as well as assessed students' science learning. The fact that every student mastered the objectives that were introduced indicates accurate analysis of student needs and successful teaching strategies. Students can, want to, and will acquire scientific skills when the materials are presented in a manner which addresses individual needs. In addition to evaluation serving as a guide for instruction, it must correspond to the skills, concepts, and factual knowledge which are taught.

Negative attitudes about any academic subject instigate a myriad of related problems from procrastination to lowered achievement. It was a goal of this practicum to foster positive attitudes about science in students and in parents. The results of the questionnaires illustrated that (for those who responded) the goal was attained. Positive attitudes in students

were a result of the successful science experiences in conjunction with a sense of accomplishment gained from hands-on activities. Parental attitudes were a function of parent-school cooperation, formal and informal communication, and parental involvement.

Although the writer did not measure teacher attitudes during the course of implementation, she noted their participation and dedication in developing instructional units, the obvious enthusiasm during science lessons, and the interest shown in obtaining materials and new activities.

The results of this practicum demonstrate that barriers to science instruction can be overcome. However, one cannot view these results at face value and disregard the processes which were involved in their accomplishment. The writer attributes the positive outcomes in this practicum to a full understanding of the change process and the utilization of a proven change model throughout implementation. By building goal

commitment, maintaining open channels of communication, affirming administrative support, and addressing teacher concerns, obstacles to implementation became challenges.

In conclusion, the improvement of science education is an attainable goal. To initiate change in science curriculum one must begin with the classroom teacher and an understanding of the change process.

With teacher expertise and knowledge of the students in conjunction with the guidance and support of administration, barriers to science instruction are reduced and science can become a focal point for daily instruction. Activity-based experiences, subject integration, and home assignments raise the importance of science for students, increase time allotments, improve instructinal methods, and invite parental support. Active involvement and opportunities to achieve develop positive attitudes about science in students and parents. Finally, the development of assessment strategies which monitor student

progress for subsequent instruction and accurately assess scientific skills and concepts eliminates the discrepancy between what we teach and what we test.

Recommendations

The writer suggests the following recommendations for continuation of the improvement in science education at the target school:

1. Development of K-5 science units which are interdisciplinary, developmentally specific, community oriented, concept related, and which communicate clearly the purposes and goals of science education.
2. Develop evaluation techniques and strategies in grades K-5 which monitor student progress for improving instruction and to appropriately assess student knowledge.

3. Utilize shared decision-making activities to establish site-based needs, priorities, and program implementation in science curriculum.
4. Investigate opportunities for staff development to improve science instruction, content knowledge, and classroom management techniques. Within the framework of staff development which empowers teachers to improve science education, there must be a focus of commitment, an awareness of the need for improvement, demonstration and guided practice in effective instructional strategies, enhancement of content knowledge, and methods of supervision.
5. Involve the community in the process of improving science education. Whether through grants, guest speakers, senior mentors, home and/or community projects, or newletters, elementary schools must broaden real and imagined school

paramenters.

Dissemination

The results of this practicum were shared with the target school principal and the faculty. The principal was impressed by the improvement of student learning, the feasibility of evaluation alternatives, and the involvement of teachers in curriculum innovation. Faculty members expressed interest in hands-on science units at all grade levels.

In the future, the writer intends to share practicum results with other school level and district administration during sharing sessions and workshops and to formalize first grade science units into resource packets for grade level distribution. In addition, the writer is in the process of summarizing the practicum and the results for journal publication.

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APPENDIX A

STUDENT ENROLLMENT INFORMATION

		Race				Sex	
	Total	Black	White	Hispanic	Other	M	F
Enrollment	752	40%	45%	15%	*	56%	44%
Attendance	91%	89%	92%	91%	94%	91%	92%
Suspensions							
In-school	0	0	0	0	0	0	0
Out-of-school	12	6	6	-	-	10	2
Explusions	-	-	-	-	-	-	-

*Less than one percent.

APPENDIX B

STUDENT QUESTIONNAIRE ON ATTITUDES TOWARDS SCIENCE

DIRECTIONS: The teacher will read all statements orally. Students respond by coloring in a happy face if they agree with the statement or a sad face if they do not.

1. I like science time at school.

2. The science activities were fun to do.

3. I think that I can use what I learned in science.

4. My teacher likes science.

5. Plants are interesting.

6. I liked what I learned in science.

7. Writing about the things we learned in science is interesting.

8. I had enough time to complete my science activities.

9. I think I do well in science.

10. I look forward to making things in science.

APPENDIX C

PARENT QUESTIONNAIRE ON ATTITUDES TOWARDS SCIENCE

DIRECTIONS: Please respond to each of the following statements by circling yes or no. Return this questionnaire to your child's teacher as soon as possible. Please feel free to write comments. Thank you for your cooperation.

1.	My child enjoys science.	Yes	No
2.	I feel involved in my child's science education.	Yes	No
3.	My child enjoys science activities at school.	Yes	No
4.	I have noticed my child completing science activities at home.	Yes	No
5.	I have received communications about my child's science program.	Yes	No
6.	I know what my child is doing in science.	Yes	No
7.	The science curriculum meets my child's needs.	Yes	No
8.	I enjoy participating in my child's science activities.	Yes	No
9.	The science curriculum is useful.	Yes	No
10.	My child talks about science at home.	Yes	No

APPENDIX D

PERFORMANCE SKILLS/OBJECTIVES FOR SCIENCE INSTRUCTION ON PLANTS, ENVIRONMENT, AND THE FIVE SENSES

PLANTS

Skill/Objective 1: Identify the parts of a plant.

Skill/Objective 2: Identify environmental conditons necessary for growth.

Skill/Objective 3: Identify the stages of plant growth.

Skill/Objective 4: Know methods by which seeds are disbursed.

ENVIRONMENT

Skill/Objective 1: Identify ways in which plants and animals are adapted to the environment.

Skill/Objective 2: Give examples of air and water pollution.

Skill/Objective 3: Give examples of ways in which air and water can be kept clean.

Skill/Objective 4: Relate animal adaptations to specific habitats.

THE FIVE SENSES

Skill/Objective 1: Identify basic shapes (square, circle, rectangle, triangle)

Skill/Objective 2: Describe objects based on color, shape, texture, and size.

Skill/Objective 3: Distinguish between objects that have an odor and those that do not.

Skill/Objective 4: Sort a set of objects according to similarities and differences using one property.